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ANNUAL REPORT

OF THE

SUDAN VETERINARY SERVICE,

1930

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STAFF.

The following staff changes occurred during the year :-

Mr. J.T.R.Evans, M.R.C.V.S., B.Sc., was appointed Assistant Veterinary Research Officer with effect from 29th October, 1930.

Three additional Veterinary Inspectors were appointed :- Mr. J.A. Gillespie, M.R.C.V.S., with effect from 21st September, 1930, and Messrs. W.Gray, M.R.C.V.S., and T.W.Stobo, M.R.C.V.S., with effect from 1st October, 1930.

The death of Mr. Cornelius Francis Magnier, M.R.C.V.S., which occurred in Khartoum on 22nd November, 1930, as the result of an accident, is recorded with deep regret. His sterling qualities and charming personality endeared him to all who came in contact with him and he is a great loss not only to this Service but to the profession to which he belonged.

In the latter half of the year a Veterinary Inspector was permanently posted to Upper Nile Province, and the distribution of the staff on 31st December, 1930, was as follows :-

Name.	Designation.	Station.
Mr. W. Kennedy, D.S.O.	Director.	Khartoum.
Captain R.S. Audas, M.C.,4N.	Asst/Director.	"
Mr. S.C.J.Bennett, B.Sc.	Veterinary Research Officer.	"
Mr. J.T.R. Evans, B.Sc.	Asst/Veterinary Research Officer.	* Malakal.
Captain J. Going, 4N.	Veterinary Inspector.	Kassala.
Captain. C.P. Fisher.	"	El Dueim.
Major J.R.Ellison	"	Khartoum.
Captain T.Menzies,D.V.S.M.(Vict)	"	El Fasher.
Captain H.B. Williams, O.B.E.	"	El Obeid.
Captain L.E. Prichard, O.B.E.	"	Wad Medani.
Mr. C.W. Pembrey.	"	Singa.
Mr. W.H. Glanville.	"	Malakal.
Mr. A.B. MacIntyre.	"	* Malakal.
Mr. J.E. Furney.	"	Shendi.
Mr. J.A. Gillespie.	"	El Obeid.
Mr. W. Gray.	"	Kassala.
Mr. T.W. Stobo.	"	Wadi Halfa.

* On temporary duty.

During the year the Director visited The Fung, Blue Nile and Kassala Provinces: the Assistant-Director visited Kordofan Province and toured in Darfur Province for two months: Major J.R. Ellison visited Wadi Halfa and toured in Upper Nile Province for two months.

The Veterinary Research Officer was absent from headquarters for a fortnight in April inspecting the serum station at Malakal, and Mr. A.B. MacIntyre, Veterinary Inspector, was in charge of that station from January 18th until July 8th.

The Director and the Veterinary Research Officer attended the International Veterinary Congress held in London from August 4th to 9th.

Consequent to a decision to abolish the Military Veterinary Department of the Sudan Defence Force the Civil Veterinary establishment was increased by three Veterinary Inspectors and the veterinary care of all Military animals devolved on the Sudan Veterinary Service with effect from 31st December, 1930.

TRIBAL VETERINARY ORGANIZATIONS.

Reference was made in last year's report to a proposal that tribal retainers, selected by the Chiefs of the cattle-owning tribes, be given a course of training in such veterinary work as would make them useful to their tribes in the control of diseases of livestock. During the period under review considerable progress was made in giving effect to this proposal and several of these retainers have already undergone a course of training and have been returned to their various areas for duty. In addition to training these men to detect outbreaks of disease in the early stages, to take the necessary steps to prevent the spread of disease, and to administer serum and vaccine as required, it is intended to instruct them in such subjects as the castration of animals considered unsuitable for breeding purposes, the flaying and preparation of hides and skins for market, and the preparation of samn (clarified butter). Some difficulty has been experienced in obtaining men of the right type for the work but, from reports received, it would appear that if they are carefully selected, patiently trained in their duties and kept under close supervision, their services should, in course of time, prove of great value to the communities they serve. It is hoped that it will be found possible, during the coming year, to make steady progress in building up the tribal veterinary organization aimed at.

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SECTION I.

DISEASES OF ANIMALS.

I. DISEASES OF CATTLE.

From a veterinary point of view the outstanding feature of the year has been the widespread occurrence of cattle plague throughout the cattle-breeding areas of the country. After allowance has been made for the greater willingness evinced by stock-owners to report the existence of disease, it is evident that there has been a marked increase this year in the incidence of cattle plague, particularly in the provinces of Kordofan and Darfur. Unfortunately the outbreaks were frequently so numerous and extensive as to overtax the resources of the Veterinary Service and, at times, neither sufficient staff, nor adequate supplies of cattle plague anti-serum, were available to cope with them. The efforts made to combat the disease included the production of nearly double the quantity of serum originally estimated as likely to be required, and the veterinary staff was thereby enabled to render invaluable assistance to stock-owners by saving the lives of many thousands of cattle.

The progress recorded in last year's report as having been made in securing the confidence of the cattle-owning tribes, in the measures adopted to control disease, was even more marked this year on account of the greater prevalence of cattle plague; and it is deeply regretted that it was not always possible to render veterinary aid when called upon. Fortunately, there was a marked diminution in the number of reported outbreaks of contagious bovine pleuro-pneumonia, otherwise the position would have been rendered much more difficult.

CATTLE PLAGUE.(Rinderpest).

As mentioned above, cattle plague was widespread during the year throughout the central Sudan and caused heavy losses, of which nearly seventy per cent were recorded in the provinces of Kordofan and Darfur.

The losses suffered in Kassala, The Fung and White Nile Provinces although considerable, were not as heavy as in the previous year.

Cattle plague was introduced into Dongola Province in November and December by cattle brought from Kordofan and Khartoum Provinces for slaughter. The outbreaks which resulted gave rise to considerable anxiety, since in 1922, when the disease last appeared in that Province, such a heavy mortality occurred amongst the work oxen, used by the cultivators to raise water from the river for irrigation purposes, that famine conditions resulted. Fortunately the natives are now so alive to the danger of cattle plague that the outbreaks were

promptly reported and the Province authorities were thereby enabled to adopt effective measures for the control of the disease before it gained a firm foothold.

The total number of the deaths reported from cattle plague during the year was 15,425 and, of this number, 6,864 or over forty-four per cent. occurred in Kordofan Province. The Veterinary Inspector, Kordofan Province, reports that his returns do not include all outbreaks which occurred as the disease was so widespread throughout the Province at one time that it was quite impossible to deal with them all with the staff at his disposal; furthermore, owing to the supplies of serum proving inadquate, many outbreaks were not dealt with in time to prevent the occurrence of a high mortality.

Similar reports, received from other Provinces which suffered heavy losses, emphasize the necessity of the provision of adequate supplies of cattle plague anti-serum. When a commencement was made in 1928 to produce the country's serum requirements locally, the first year's work was in the nature of an experiment but it was, nevertheless, found possible to produce 18,000 doses of serum of high potency. Although this amount was well above the average quantity used in the previous six years it was considered that an increased demand must be anticipated, and arrangements were made to produce 30,000 doses in 1929. With a view of further developments, the erection of permanent buildings and quarters at the Serum Station at Malakal was undertaken during the past year and, although those buildings were not ready for occupation during the working season, and delays occurred in obtaining the required cattle, 34,320 doses were produced before the advent of the rainy season. As soon as it became evident that this quantity was inadequate, the Veterinary Research Officer made arrangements to undertake serum production in Khartoum, and he succeeded in producing 22,480 doses. The total quantity of serum made available during the year, therefore, was 56,800 doses and, when the difficulties which had to be contended with in producing this quantity are considered, the result obtained reflects great credit on the Laboratory staff. With the facilities now available at Malakal it is hoped that it will be possible to produce at least 60,000 doses next year.

The position in regard to cattle plague cannot be regarded as satisfactory until such time as a sufficient supply of anti-serum is available to permit of reserves being held, at various strategic points, throughout the cattle-breeding areas of the country. In this way only will it be possible to obviate the dealays, which have so frequently occurred in the past, in supplying urgent requirements. In order to provide the reserves referred to, it will be necessary to increase the output of serum still further and, with this object in view, approval has been obtained for Ø some increase of the native staff. Further information on the subject of serum production will be found in the appended report of the Veterinary Research Officer.

The consolidated returns of outbreaks of cattle plague for the past three years are given below but, as previously stated, it is almost impossible to assign true values to such figures for purposes of comparison :-

Ø **the extension of the buildings at the serum station and for**

	No. of outbreaks.	No. of cattle involved.	No. of deaths.
1928.	525	91,603	7,137
1929.	795	124,406	12,743
1930.	981	180,540	15,425

In dealing with the various outbreaks of cattle plague in the Provinces 60,383 head of cattle were given cattle plague anti-serum. The numbers inoculated in each Province were as follows :-
Berber 3,096, Blue Nile 8,202, Darfur 11,752, Dongola 570, The Fung 5,238, Halfa 30, Kassala 7,998, Khartoum 429, Kordofan 10,166 and White Nile 12,902.

Towards the end of last year the buffalo in the Opari-Kajo Kaji district of Mongalla Province were reported to be dying of cattle plague and, in January of this year, the disease appeared among buffalo in the Latuka district. An outbreak occurred among cattle in March in the township of Mongalla and caused a mortality of approximately fifty per cent in herds totalling over 800 head. Later in the year further outbreaks were reported at Juba and in the Terrakeka and Uffudo areas. It was considered probable by the Province authorities that infection was originally introduced from Uganda by game.

No returns are available from Bahr-el-Ghazal and Upper Nile Provinces but cattle plague was reported to be widespread and causing heavy losses in some parts of Upper Nile Province at the end of the year.

In view of the prevalence of cattle plague in Kordofan Province during the year it is not surprising that the export trade in cattle from that Province was seriously interferred with on more than one occasion. The delays in forwarding cattle to Egypt, owing to disease appearing amongst them while in transit, caused considerable loss to the cattle merchants concerned. Two hundred and ninety-five cattle died or were destroyed on account of cattle plague in the various quarantine stations during the year.

CONTAGIOUS BOVINE PLEURO-PNEUMONIA.

The returns of outbreaks of contagious bovine pleuro-pneumonia show a marked improvement on last year's figures, and the total mortality recorded in the Provinces was 494 head, as compared with 1,340 in the preceding year.

The disease was most prevalent in the Provinces of Darfur, Kordofan and Kassala but the total number of outbreaks which occurred in those areas was only fifty-seven as compared with one hundred and fifty-five in the previous year. To meet the requirements of the veterinary staff in dealing with the various outbreaks, and in conferring immunity on cattle occupying areas threatened by the disease, 15,700 doses of vaccine were issued from the Veterinary Laboratory during the year. The demand for vaccine would undoubtedly have been much greater than it was if the field staff had not been so fully occupied in dealing with outbreaks of cattle plague.

In spite of the pressure of work thrown on the Laboratory staff by the demands for cattle plague anti-serum, and for vaccine against contagious bovine pleuro-pneumonia, it was nevertheless found possible to carry out certain observations and experiments in connection with the keeping qualities of this vaccine - a matter of great practical importance. Full details of these observations and experiments will be found in the report of the Veterinary Research Officer, but the following valuable deductions made therefrom may be quoted :-

"(a) It is advisable to use virus culture
" vaccine as soon after preparation as possible.
"(b) Owing to the relatively slow rate of
" deterioration on storage in the cold over short
" periods it is permissible to carry small stocks
" in the Laboratory.
"(c) Owing to the more rapid deterioration of
" vaccine when stored at 37°C, a temperature
" that may be accepted as fairly representative
" of shade temperatures in out-stations in the
" Sudan, the control of contagious bovine pleuro-
" pneumonia by vaccination assumes two aspects :-
"(i) In the case of herds in which the disease
" has already appeared, or for herds
" imminently threatened, vaccination should
" be conducted with cultures freshly issued
" from the Laboratory. In such herds a
" rapidly induced immunity is of the first
" importance, and it has been seen that a
" storage period of even a fortnight at
" 37°C. retards the rate of immunity
" development.
"(ii) In the case of herds less imminently
" threatened, or for herds in which
" vaccination is to be adopted as a long
" range precautionary measure, it is, although
" still desirable, not so necessary to use
" the freshest possible cultures; storage at
" 37°C. for ten or eleven weeks would in
" extreme instances be permissible."

Other observations by the Veterinary Research Officer on the course of a natural outbreak of contagious bovine pleuro-pneumonia in a small herd of cattle, in which no control measures were employed, are also of considerable value.

Forty-eight cases of contagious bovine pleuro-pneumonia came under notice during the year among cattle awaiting export to Egypt as compared with thirty-nine cases in 1929 and forty-six cases in 1928.

This disease is known to be prevalent in Bahr-el-Ghazal Province but, in the absence of veterinary staff in that area, no returns are available. The Veterinary Inspector, Upper Nile Province, reported towards the end of the year that the disease was causing heavy losses north of Bor but as a Veterinary Inspector was only posted to this Province in October, our knowledge of the disease now prevailing there is still very incomplete.

FOOT-AND-MOUTH DISEASE.

No outbreaks of this disease were reported during the period under review.

ANTHRAX.

Only one case of this disease came under notice in cattle during the year. It was diagnosed in a cow which died in Kassala in February.

PSOROPTIC MANGE.

A few cases of psoroptic mange occurred in work oxen in the Gezira irrigated area.

TRYPANOSOMIASIS.

Several cattle succumbed to trypanosomiasis in Gedaref township and cases of this disease were reported from the Western Genels district, Kordofan Province. The following tsetse flies were caught in The Fung Province, an area in which their presence was hitherto unrecorded :-

Glossina palpalis, Khor Yabus, Kurmuk District.
Glossina morsitans, El Gazref, Roseires District.

PIROPLASMOSIS.

Two young purebred Ayrshire bulls, imported from Scotland in October with a view of effecting an improvement of the breed of cattle in the Belgravia Dairy herd, unfortunately died of Theileriasis within a few weeks of their arrival in the country.

II. DISEASES OF CAMELS.

The total losses suffered among camels for which forage allowance was drawn amounted to three hundred and ninety-four this year, as compared with four hundred and sixty in 1929, and three hundred and twenty-six in 1928. These figures include animals which were cast for various reasons, such as "old and worn out", amounting to about a quarter of the total, and, when the hardships to which the police camels were exposed in those areas where the recent campaign against locusts was vigorously prosecuted are taken into account, the losses recorded cannot be considered remarkable. The majority of the losses occurred in the provinces of Kordofan, Kassala and Darfur. Deaths from trypanosomiasis amounted to forty-three this year, compared with one hundred and twenty-three in 1929, and eighty-two in 1928. The marked decrease in the losses from this disease is mainly attributable to improved methods of diagonosis and to the free use of "Naganol".

The losses from trypanosomiasis among army camels amounted to fifteen per cent of the total losses from all causes and the following figures, kindly supplied by the Military authorities, enable a comparison to be made with previous years :-

	Total Losses from all causes	Losses from Trypanosomiasis
1927	126	27
1928	127	7
1929	114	7
1930	99	15

Eight hundred and thirty camels suffering, or suspected to be suffering, from trypanosomiasis were treated with "Naganol" during the year - more than double the number treated in the previous year. It is interesting to record that one hundred and forty-nine camels belonging to Sheikhs and notables in Kassala Province were treated, on payment, with "Naganol" as compared with sixty-eight last year.

The mercuric chloride test for trypanosomiasis to which reference was made in last year's report, has been adopted as the routine method of diagnosis with very satisfactory results. The routine method of treatment still consists in the intravenous administration of a single dose of ten grammes of "Naganol" but experiments are in progress to test the effi-cacy of smaller doses. The possible existence of equine "reservoirs" of the local camel trypanosome was the subject of investigations carried out by the Veterinary Research Officer during the year. His conclusions are that donkeys may become "reservoirs" of infection and, therefore, in dealing with outbreaks in camels, it is advisable to treat any donkeys which may be in close contact with the infected camels.

Several outbreaks of mange occurred among police camels during the year but this condition does not appear to have been more prevalent than usual among native-owned camels.

A case of anthrax occurred in a police camel at Kassala in March.

Prussic acid poisoning, resulting from feeding on immature durra, was responsible for the deaths of five camels in Khartoum, and a few cases of rigworm came under notice in The Fung Province.

III. DISEASES OF EQUINES.

AFRICAN HORSE SICKNESS.

The mortality from African Horse-Sickness during the period under review was the smallest recorded for several years and is attributable to the moderate rainfall experienced in those areas where horses are kept. The returns of the casualties caused by this disease among the horses and mules of the Government service during the last four years are as follows :-

		Horses	Mules.	Total.
1927.	...	42	67	109
1928.	...	24	16	40
1929.	...	27	44	71
1930.	...	14	11	25

The horse-owning tribes of Southern Darfur and Kordofan report that their losses have been much less than usual.

In an interesting report received from the Veterinary Inspector, Blue Nile Province, it is stated that an outbreak of this disease occurred in a number of donkeys in a village near Kilo 7, on the main irrigation canal, and that eighteen out of twenty donkeys succumbed.

EPIZOOTIC LYMPHANGITIS.

Epizootic Lymphangitis was definitely diagnosed at the Veterinary Research Laboratory from material forwarded from seventeen horses, thirty-two mules and fifteen donkeys during the year.

Eleven cases occurred in horses in Kordofan Province, where the disease was very prevalent last year, and the Veterinary Inspector in charge reports that the position in regard to this disease shows considerable improvement, particularly in the area occupied by the Messeria tribe.

Of the thirty-two cases recorded in mules, ten occurred in The Fung Province, six in Kordofan Province and six in Upper Nile Province. Thirteen cases occurred in Blue Nile Province in native-owned donkeys in outlying villages where the disease was found to be very prevalent.

Some very interesting observations were made by the Veterinary Research Officer during the year on the occurrence of an apparently primary pneumonia of equines, presumably resulting from infection by the causal organism of epizootic lymphangitis (Cryptococcus farciminosus). These observations are to be found in the appended report of the Veterinary Research Officer and have an important bearing on the measures to be adopted for the control of the disease.

TRYPANOSOMIASIS.

Cases of trypanosomiasis due to T. brucei were diagnosed at the Laboratory in blood smears forwarded from two horses in the Gambeila Enclave, in blood smears from a mule in Southern Darfur, and in two donkeys which had been enough engaged in transport work in Upper Nile Province.

One case of infection by T.congolense was diagnosed in a police pony in the Nuba Mountains.

GENERAL.

A mild outbreak of strangles occurred among the animals of the Cavalry and Mounted Rifles at Shendi in August and September, and seven cases occurred during the year in Khartoum. Two cases of tetanus were admitted to the Khartoum Veterinary Hospital for treatment of which one (a horse) died and the other (a mule) recovered. Ringworm was reported to be very prevalent among native-owned donkeys in The Fung Province.

IV DISEASES OF SHEEP AND GOATS.

With the exception of the following notes on the occurrence of anthrax and of the disease known as "heartwater" there is little of interest to report in connection with diseases affecting sheep and goats.

ANTHRAX.

One case of anthrax came under notice early in the year in a sheep received at the Quarantine Station, Wadi Halfa, from Kassala. Infection in this case appeared to have been contracted at Kassala prior to despatch.

HEART-WATER.

This disease is reported to have caused fairly heavy losses in a flock of sheep on the Gezira Research Farm, Blue Nile Province.

V. DISEASES OF DOGS.

RABIES.

Rabies was definitely diagnosed during the year in material forwarded for examination from the following places :-

Nahud, Kordofan Province, in January,
Bahr-el-Ghazal Province, in February,
El Obeid, Kordofan Province, in March,
Khartoum, in April,
Omdurman, in August,
Wad Medani, Blue Nile Province, in December, and
El Dueim, White Nile Province, in December.

Suspected cases of the disease were reported from Darfur and Kassala Provinces but the situation in the latter Province improved to such an extent that it was found possible to remove all restrictions on the movement of dogs by the end of July.

The outbreaks which occurred in the towns of Omdurman and Khartoum caused little apprehension owing to the effective control measures adopted by the Province Police.

In one district of Bahr-el-Ghazal Province the disease was reported to have become widespread and, in the case of dogs, to have assumed the proportions of an epizootic.

The outbreaks reported in Blue Nile Province towards the end of the year is causing a certain amount of alarm, as infection appears to be fairly widespread in the thickly populated irrigated area.

The Rabies Ordinance of 1911 was repealed and a new ordinance entitled "The Rabies Ordinance, 1930", was promulgated, the provisions of which should greatly

facilitate the effective control of the disease.

SECTION II.

TRADE IN LIVESTOCK AND LIVESTOCK PRODUCTS.

I. EXPORT AND IMPORT TRADE.

CATTLE AND SHEEP.

The total numbers of cattle and sheep exported during the period under review were 9,520 cattle and 5,702 sheep. These figures are the lowest recorded during the past twenty years.

The local supplies of cattle and sheep were fairly well maintained during the trading season and, although outbreaks of cattle plague interferred to some extent with the free movement of cattle, the decreases in exports are almost entirely attributable to the poor prices obtaining on the Egyptian meat markets. There is little doubt that the cattle merchants have had a most unprofitable year and indications are not lacking that they are now anxious to dispose of their stocks as quickly as possible in an endeavour to cut their losses.

Further details of the trade in cattle and sheep are given in the following tabulated statements :-

A. Numbers and values of cattle and sheep exported during the last four years.

Year.	Cattle.	Sheep.	Valuation at port of export
1927.	13,460	14,158	£E. 86,691
1928.	11,114	13,961	" 75,732
1929.	10,412	15,079	" 84,045
1930.	9,520	5,702	" 60,041

B. Numbers of cattle imported during the last four years.

Year.	French Equatorial Africa	Eritrea	Abyssinia	Total.
1927.	1,844	805	573	3,222
1928.	1,029	127	1,511	2,667
1929.	2,834	290	1,743	4,867
1930.	3,170	8	1,605	4,783

C. Origin of cattle exported during the past three years.

Province.	1928.	1929.	1930.
Darfur and Kordofan.	7,656	7,764	6,465
White Nile.	1,129	784	355
Upper Nile.	684	847	453
Bafr-el-Ghazal	74	-	305
Blue Nile	60	-	-
Khartoum	436	122	302
Berber	1,050	895	1,640
Red Sea	25	-	-
Total.	11,114	10,412	9,520

D. Average market prices and total numbers of cattle sold for export in El Obeid market during the last four years.

Year.	Number of cattle sold	Average price. £E.m/ms.
1927.	6,855	2.981
1928.	7,034	3.338
1929.	7,675	3.355
1930.	5,780	3.033

CAMELS.

The effects of the trade depression in Egypt are further reflected in the great decrease in the number of camels exported during the year. The Egyptian buyers who had been operating in the Khashm-el-Girba market at the end of last year ceased purchasing early in January owing to a glut of the market in Upper Egypt. Trading conditions improved in October but by the middle of November all demands appeared to have been supplied. The Rashaida, who are the local camel merchants, continued to buy at poor prices up to the end of the year with a view, apparently, of holding stocks in the hope that the market in Egypt will improve.

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The total number of permits issued for the export of camels from Kassala Province during the year was 4,803, as compared with 9,000 last year and 6,935 the year before. The average price paid in Khashm-el-Girba market for camels intended for export was £.5 per head during the months of October and November.

In addition to the trade with Egypt one hundred and fifty-two camels were exported from Darfur Province to French Equatorial Africa, as compared with 1,450 last year and 1,801 in the previous year.

Permits to export 989 camels to Egypt were issued at Khartoum during the year, and 365 camels were exported by road to Upper Egypt from Kordofan.

MULES.

Fifty-three mules were imported from Abyssinia during the year, while the imports in 1928 and 1929 were three hundred and twelve and three hundred and eighty-five respectively.

HIDES AND SKINS.

The following tabulated statement, compiled from the Customs returns, shows the exports of hides and skins, and the value of same, for the last five years :-

		Hides. Tons	Skins. Tons.	Total Value £
1926	...	428	821	126,431
1927	...	1,067	932	155,285
1928	...	2,309	1,880	298,623
1929	...	1,328	1,013	185,898
1930	...	1,049	950	138,854

There was no strong demand for hides at any time during the year and the prices offered locally declined from around £.40 per ton at the beginning of the year to as low as £.24 in September. A slight recovery was noticeable in October and November on receipt of some orders from Syria but, at the end of the year, the prices offered were only in the neighbourhood of £.25 per ton. When all the circumstances are taken into account the export of over one thousand tons of hides must be regarded as a very satisfactory achievement.

Exports of hides to Great Britain declined from six hundred and ninety-nine tons in 1929 to three hundred and thirty-eight tons this year, whereas exports to Turkey and Syria increased from about one hundred tons in 1929 to a total of three hundred and seventy-one tons.

The average prices offered locally for sheep skins were P.T.21 for selected slaughter-house skins and P.T. 14 for other qualities. These figures represent a drop of nearly four piastres per piece on the prices obtaining last year ; in the case of goat skins the fall in prices was equivalent to two milliemes per piece. On the whole, therefore, the export figures for skins for the period under review may be considered satisfactory.

The following information in regard to the classification of six hundred and fifty-eight tons of hides exported during the year has been kindly supplied by the merchants who handled the consignments:-

Classification of hides.	Number of hides.	Total weight Tons.	Percentage by weight.
Fasher flint-dried.	27,800	160	24.3
Dry salted. ...	15,463	156.7	23.8
Fashoda. ...	75,934	341.7	51.9
		658.4	100.0

The average prices offered for "Fashoda" hides in Omdurman market during the past four years were £.60.5 per ton in 1927, £.32.7 in 1928, £.48.2 in 1929 and £.29 in 1930.

The average weights of the hides and skins exported during the year were 6.49 kilogrammes per hide, 2.1 kilogrammes per sheep skin, and .65 kilogramme per goat skin.

SAMN OR MASLEE (CLARIFIED BUTTER).

The following statement shows the exports and imports of samn, according to the Customs returns, for the last three years :-

	1928.		1929.		1930.	
	Tons.	Value	Tons.	Value.	Tons.	Value
		£		£		£
Exports.	181	16.[illegible]9	261	22,493	284	22,516
Imports.	15	941	24	1,941	25	1,858

Four hundred and fifty-seven tons of samn were despatched during the year from El Obeid by rail to various local markets and, of this quantity, two hundred and sixty-three tons were consigned to Port Sudan and Wadi Halfa, presumably for export. Large quantities of samn are produced annually in White Nile Province and, in the past year, over two hundred tons left that area by rail.

II. INTERNAL TRADE.

MEAT SUPPLIES.

The numbers of animals slaughtered for food in ten of the larger towns during the past three years, are as follows :-

		1928.	1929.	1930.
Cattle.	...	27,601	22,599	22,230
Sheep.	...	142,444	166,362	159,350
Goats.	...	8,650	13,230	10,956
Camels.	...	2,712	2,467	2,756

A comparison of the figures for 1930 with those of 1929 reveals an increase of 289 camels slaughtered and decreases of 369, 7,012 and 2,274 respectively in the numbers of cattle, sheep and goats slaughtered.

In the report of last year the returns of animals slaughtered for food in Blue Nile Province during the year were shown in detail. In some cases the returns are compiled from records kept at the various centres but, in other cases, the figures given are estimates only. Such figures cannot be regarded as complete or very accurate but, in the aggregate, they are considered to give a very fair indication of the type and quantity of meat consumed, particularly in the Gezira area, and, since they possess a value for purposes of comparison, the consolidated returns for the past three years are given below :-

Year.	Cattle.	Camels.	Sheep.	Goats.
1928 ...	11,300	3,280	43,050	880
1929 ...	9,580	4,080	68,900	9,870
1930 ...	5,660	2,150	45,680	1,850

Over six thousand head of cattle and upwards of five thousand sheep were imported into Blue Nile Province, for sale or slaughter, from Kordofan and White Nile Provinces during the year.

In the Gash delta, Kassala Province, it is estimated that 785 cattle, 11 camels, 2,622 sheep and 625 goats were slaughtered for food during the year, as compared with 1,258 cattle, 23 camels, 3,292 sheep and 515 goats in the previous year.

SECTION III.

IMPROVEMENT OF LIVESTOCK.

CATTLE.

Further efforts were made during the year to encourage the cattle-owning tribes in Southern Darfur and Southern Kordofan to infuse fresh blood into their herds and to sterilise all bulls considered unsuitable to breed from. Since the original stock in Southern Darfur and in Western Kordofan appears to have been mainly of western origin it was decided to look to the east for fresh blood, and forty good stud bulls were purchased in White Nile Province in October and distributed, half in Southern Kordofan and half in Southern Darfur. Some time will elapse before it will be possible to assess the true value of the results of the introduction of these bulls but, if these are good and sufficiently striking to impress the natives concerned, it is possible they may suffice to encourage the tribal authorities to undertake further importations of stud bulls from White Nile Province on their own responsibility.

It is reported that seven half-bred bulls have died out of ten which were despatched from the Government dairy herd at Khartoum North to various centres in Upper Nile Province. With one exception, a bull at Renk, these animals failed to thrive under local conditions even when the natural grazing was supplemented by a grain ration. They appeared to be worried much more by flies than the native cattle are and did not stand the heat in the cattle sheds too well during the rains.

A report has been received on a half-bred Friesian bull which was despatched to Wau, Bahr-el-Ghazal Province, in July, 1929, for use with the dairy herd there. This bull took some time to get acclimatized but is now functioning satisfactorily. He is kept under artificial conditions, is housed in a fly-proof shed with an exercising paddock adjoining and is given cut forage and a ration of grain and oil-cake. It will be interesting to see if his progeny will be able to withstand local conditions.

Two pure-bred Ayrshire bulls were imported in October for use in the Belgravia Dairy herd at Khartoum North. It was hoped that by introducing this breed it would be possible to produce half-bred cattle of a hardier type than the Friesian cross and more likely to survive on poor pasture. Unfortunately both the bulls succumbed to "tick fever" (Theileriasis) within a few weeks of their arrival.

Improvement of native cattle by a process of selective breeding is being carried out on a small scale on the Gezira Research Farm, and the Chief Inspector in charge reports that good progress is being made.

HORSES.

The horse improvement scheme progressed satisfactorily during the year and the reports received, particularly from Darfur and Kordofan Provinces, are distinctly encouraging.

The Assistant Director reports as follows on the year's work :-

"Although the scheme was inaugurated in Darfur and "Kordofan in the winter of 1925-26 some time elapsed before "its objects were properly understood and appreciated by the "natives. The mares selected for registration were, in "most cases, in foal when registered so that it took, altogether, "about eighteen months to obtain the first crop of improved "foals. Since then it has been possible to record steady "progress each year along sound and popular lines. The "stallion power has been increased, adequate stabling has "been provided and the results obtained have certainly come "up to, if not exceeded, expectations.

"The progress recorded in Kordofan Province this "year has been remarkable. A number of young improved stock "was produced at Muglad horse show and, in Dar Messeria, "many good young half-bred ponies were offered for sale. "It is gratifying to be able to state that the Messeria "are rapidly regaining lost ground and are now anxious to "emulate the example of their neighbours in Darfur. This "improvement in the attitude of the tribe towards the horse "improvement scheme is attributable to the untiring efforts "of the Veterinary Inspector in charge ably supported by the "province officials concerned.

"At the various shows held recently in Darfur the "following animals, bred by Government-owned stallions, were "produced for inspection :-

	Colts.	Fillies.
Foals. ...	110	92
Yearlings ...	146	140
Two years' old and over	123	82

"These numbers do not represent the total by any "means as many of the half-breds produced in the Nyala and 'Id-el-Ghanam areas were not inspected at the horse shows.

"The Veterinary Inspector, Darfur Province, "reports that the horse-owning tribes experienced "considerable hardship during the year owing to a shortage "of grain resulting from the depredations of locusts and "birds, and a shortage of milk through losses among their "cattle from cattle plague. He considers that these "shortage are bound to have a bad effect on the horse "improvement scheme as there will be a scarcity of food "for both the brood mares and their foals.

"The number of services given in Kordofan and "Darfur during the year was five hundred and four and five hundred and forty-eight respectively.

"A few good foals were produced in Khartoum "District this year and, when the local conditions and the "cost of feeding etc. are considered, the results are "better than one would be inclined to anticipate.

"The Officers of the Cavalry and Mounted Rifles "at Shendi deserve credit for the way in which they have "succeeded in fostering horse improvement in that area. "Owing to their efforts the native horse owners are very "keen to improve their breed of pony, and quite a number "of half-bred and three-quarter-bred ponies have been "produced in the district.

"In the Gezira area some members of the staff of "the Sudan Plantations Syndicate, and quite a number of the "tenants, have taken to horse-breeding, and a fair number "of foals were produced during the year.

"The following list shows the distribution of "Government stallions as at 31st December, 1930 :-

"Darfur Province:- Oberto, Tom Bowling and No Joke (English "thoroughbreds); Diamond Jubilee (Egyptian country-bred); "Kiolan, Allahom, Talab, Monarch, Assad Kerim, Escort, "Rafdan, El Nazir, El Sheikh, Nasr-el-Din, El Butt, Cinders, "Fil-Fil, Tigre Royal*, Gambeil, The Omda, Pintail*, Kasab,* "and Wayel*(Arabs); Ziada and Master Wimpole*(Sudan country-"breds).

"Kordofan Province:- Farad, Irrigation, Mutamad, Murgan, "Ein-el-Shems, Dinar* and Economy* (Arabs); Muglad, Helbawi "and one other (Sudan country-breds).

"Khartoum and Shendi:- Melik, Sapper, Faisir, El Barg and "Prince John* (Arabs).

"Wad Medani:- Viaduct (English thoroughbred).

"Two stallions("Dalgum" and "Nahud") died and one "("Lulu") was destroyed in Kordofan Province; one stallion "("Paper Money") died and two ("Baccarat" and "Atbara") were "destroyed in Darfur Province during the year.

"The English thoroughbreds, "Tom Bowling","Oberto", "No Joke" and"Viaduct", are in good condition. All are good "foal-getters with the exception of "Tom Bowling" who has "very few foals to his credit, being rather too big for the "average native mare."

---

* Denotes horses put on the list during 1930.

CAMELS.

During the year the Military authorities kindly agreed to hand over to this Service five well bred Bisharin camels which were cast mainly on account of injuries to the feet. These animals were distributed among the camel-owning tribes in Northern Kordofan for use as sires.

DONKEYS.

The donkey stallions stationed in the Gezira irrigated area are reported to be functioning satisfactorily and some very good donkey foals have been produced by them.

Government-owned donkey stallions are now stationed at Nahud, Muglad and Dilling in Kordofan Province and have served a large number of mares during the year.

MULE BREEDING.

Considerable difficulties have been experienced in carrying out the hinny breeding experiment to which reference was made in last year's report. The experiment is being conducted at Nyala in Southern Darfur and the stud now consists of eighteen donkey mares and a pony stallion. The donkey mares are fed and worked in much the same way as native-owned donkeys are treated and, during the year, six of them, which were in-foal to the pony stallion, unfortunately aborted. Of the remaining twelve, one gave birth to a hinny foal and is now suckling same and eleven are definitely in-foal to the pony stallion. It is thought that the cause of the abortions which occurred has been discovered and that it will be possible to obviate similar accidents in future. This small experiment is not a costly one but the results finally obtained should be of considerable value.

SHEEP.

The following extract from a report rendered by the Chief Inspector in charge of the Gezira Research Farm, and kindly forwarded by the Director of the Department of Agriculture and Forests, gives some details of the sheep-breeding experiments in progress there :-

"At the end of the year the two separate
"flocks consisted of :-

"(a) 35 Native x Merino.
" 2 Native x Merino x Merino.

"(b) 88 Native ewes crossed with 2 Border
" Leicester rams.

"(a) Both Merino rams have now been lost - one
" died during the heavy rains and the second was
" stolen and killed during January.

"The 37 cross-bred progeny are compact nice
"looking sheep compared with the native sheep - they have
" a certain amount of wool, probably and 8 lbs. clip,
"compared with 16 lbs. which was clipped from the pure- bred
"rams. The two lambs with ¾ Merino blood have the appearance
"of purebred Merino. It is hoped that there are still a
"number of ¾ bred lambs yet to arrive.

"(b) The two Border Leicester rams, which arrived
" from Australia in January, died from pneumonia
"after only four months in the Sudan. They appeared to feel
"the heat very much. Fortunately over 70 ewes are in lamb
"to them.

"Gezira conditions are especially severe on
"imported sheep. From our short experience here it seems
"that the best method of improving the local sheep is to
"adopt the same process as has been done with the cattle,
"namely, to breed up the local animals by selection."

POULTRY.

Some valuable importations of pure-bred fowls were made by private individuals during the year, notably four White Wyandotte cocks and five hens; two White Leghorn cocks and eight hens; and two Rhode Island hens. An Incubator was also imported by a native farmer in The Fung Province.

All poultry breeders in the Sudan who are interested in the improvement of the local breed of fowl owe a debt of gratitude to Mr. G.W. Grabham, O.B.E., who was the first person to take the matter up seriously. As in all pioneer movements considerable difficulties had to be overcome before any marked success was obtained, and Mr. Grabham has always been only too willing to pass on to others the benefit of his experience and to supply improved fowls and eggs to anyone interested. During the year he distributed over 250 eggs for hatching purposes and about 100 cockerels and young chicks of improved breed. This public-spirited action is greatly appreciated.

Reports from Kassala, Blue Nile, Darfur and Kordofan Provinces are most encouraging. In Kordofan Province about 60 cockerels and 2,000 eggs were distributed during the year by the Veterinary Inspector, El Obeid.

SECTION IV.

MISCELLANEOUS.

GRAZING AND WATER.

Moderate rains were experienced throughout the central Sudan this year and the conditions in regard to grazing and water were generally favourable to stock. The rains were exceptionally poor, however, in northern Kassala and the Northern Bisharin are consequently reported to have suffered considerable hardship throughout the year.

In Upper Nile Province the rains were reported to have been the worst recorded in the last twenty years and grazing was not as plentiful as usual. Owing to the scarcity of grazing near the river large numbers of cattle are congregating at the drinking pools inland and it is feared this may result in the occurrence of widespread outbreaks of disease.

In the Gezira area the rains were not as heavy as those experienced last year, grazing was good and the condition of the animals was described as much better than last year.

LIVESTOCK SHOWS.

The third Gezira Livestock Show was held at Wad Medani on January 17th and this event once more proved to be a great success. The quality of the exhibits continued to show marked improvement and a lively interest in all classes was evinced by the native tenant farmers.

Scarcity of grazing prevented the holding of a camel show at the annual Bisharin tribal meeting in January.

Very successful borse shows were held at Muglad, Kordofan Province, and at various centres in Darfur Province during the year.

BELGRAVIA DAIRY.

The quantities of dairy produce sold from the Government dairy at Khartoum North during the year were as follows :- Fresh milk 12,437 gallons, fresh cream 254 gallons and fresh butter, 2,808 lbs. Sales of milk and butter show decreases of 419 gallons and 220 lbs. respectively when compared with last year but sales of cream show an increase of 22 gallons.

An outbreak of cattle plague occurred in the dairy herd at the beginning of March and resulted in the deaths of one cow, four heifers and ten calves; eight other cows, which contracted the disease and recovered, aborted later. In the case of this outbreak the disease first appeared among young calves in an atypical form and some time elapsed before a definite diagnosis of cattle plague could be made. As soon as the disease was identified it was promptly controlled by the administration of cattle plague anti-serum.

This unfortunate occurrence resulted in the average annual milk yield being reduced by thirteen per cent.

As mentioned under another heading two pure-bred Ayrshire bulls, which were imported in October for use with the dairy herd, died within a few weeks of their arrival in the country.

Altogether the year may be described as having been an extremely unfortunate one for the Belgravia Dairy.

VETERINARY HOSPITALS.

The numbers of animals which received treatment at the Veterinary Hospitals in Khartoum and Wad Medani during the year were as follows :-

	In-patients.	Out-patients.
Khartoum. ...	1,119	1,781
Wad Medani. ...	285	3,207

The returns of the sho~~p~~eing forge attached to the Khartoum Veterinary Hospital show that 4,352 horses and mules were shod, as against 4,731 in the previous year.

BUILDINGS.

Permanent buildings were constructed during the year at the Serum Station, Malakal, and were available for occupation at the end of the year. The provision of these buildings will greatly facilitate the production of cattle plague anti-serum next year.

Additional stabling accommodation for Government-owned stallions was provided at Nyala, Darfur Province; a row of stables was erected at the veterinary hospital at Wad Medani; a small veterinary hospital and office was built at Singa during the year; and veterinary sick lines, in course of construction at Gedaref, Kassala Province, should soon be completed.

ACKNOWLEDGEMENTS.

In again recording my appreciation of the assistance that has been rendered to the Veterinary Service by Provincial staffs and by all other Departments and Services when called upon, I would take this opportunity to thank the members of my own staff for the whole-hearted support which they never failed to give me throughout the year, no matter how trying the conditions under which they had to work.

(Signed) W. KENNEDY,

Director, Sudan Veterinary Service.

ANNUAL REPORT

OF THE

VETERINARY RESEARCH OFFICER,

SUDAN GOVERNMENT,

1930.

APPENDIX

REPORT OF THE VETERINARY RESEARCH OFFICER.

BUREAU OF HYGIENE
LIBRARY
23 SEP 1931
TROPICAL DISEASES

A. STAFF.

The classified staff during the year was as follows :-

VETERINARY RESEARCH OFFICER.

Post held by myself throughout the year.

ASST. VETERINARY RESEARCH OFFICER.

Post vacant until October 29th., when it was filled by the arrival of Mr. J.T.R. Evans, B.Sc.

Mr. A.B. MacIntyre, Veterinary Inspector, was attached to the laboratory throughout the year.

LABORATORY ASSISTANT.

Post held by Mr. P.A.C.Kenny throughout the year.

The classified staff was increased by the appointment of a Sudanese clerk as from January 1st.

TOURS.

During April I visited the temporary serum station at Malakal.

Mr. MacIntyre took charge of the serum station at Malakal in mid January, remaining until he proceeded on four months' leave in mid July, and returning on its expiry to make preparations for the 1931 working season.

Mr. Evans proceeded to Malakal on December 27th, and was absent at the end of the year.

Mr. Kenny was in charge of the Khartoum Laboratory throughout July, August and September while I was on leave.

In addition to tours I was delegated to attend the 11th. International Veterinary Congress from August 4th.-9th. during my leave.

B. ROUTINE WORK.

The main sections of routine work have been, the manufacture of cattle plague anti-serum, the preparation and issue of contagious bovine pleuro-pneumonia vaccine, the issue of testing apparatus and Naganol for the control of camel trypanosomiasis, and the examination of specimens submitted for diagnosis.

I. EXAMINATION OF SPECIMENS.

A total of 500 specimens has been examined, this number being exclusive of any examinations made in connection with research work or laboratory routine and of such specimens as have been forwarded to other departments for special examination. The following is a list of diagnoses set out under headings of animal species :-

HORSES.

Epizootic lymphangitis	17	
Pyogenic infections	31	
Nuttallia equi	4	
Piroplasma caballi	2	
N. equi and P. caballi	1	
Trypanosoma brucei	2	
Trypanosoma congolense	1	
Filariasis	2	
Habronemiasis, cutaneous	1	
Mange, psoroptic	1	
Negative	71	135

MULES.

Epizootic lymphangitis	32	
Pyogenic infections	24	
Habronemiasis, cutaneous	2	
Trypanosoma brucei	1	
Negative	22	81

DONKEYS.

Epizootic lymphangitis	15	
Pyogenic infections	7	
Trypanosoma brucei	2	
Negative	25	49

CATTLE.		
Theileriasis (see notes)	9	
Piroplasma bigeminum	6	
Anthrax	1	
Trypanosoma congolense	1	
Actinomyces farcinicus	2	
Pyogenic infections	1	
Mange, psoroptic	1	
Negative	51	72
CAMELS.		
Trypanosoma soudanense	12	
Anthrax	1	
Streptococcic pyaemia	1	
Septic pneumonia (corynebacteria)	1	
Pyogenic infection, local	1	
Negative	43	59
SHEEP.		
Anthrax	1	
Negative	3	4
GOATS.		
Negative	6	6
DOGS.		
Trypanosoma congolense	1	
Piroplasma canis	1	
Negative	40	42
FOWLS.		
Spirochaetosis	7	
Negative (including two turkeys)	32	39
PIGS.		
Cysticercus cellulosae	1	1
MISCELLANEOUS.		
Cheetah, Elephant, Hippopotamus Wild sheep, Wart hog, Parrots All Negative	12	12
Total		.. 500

II. NOTES ON SPECIMENS EXAMINED.

1. TRYPANOSOMIASIS.

As recorded in this Report for 1928 and 1929, the number of specimens submitted for examination as to trypanosomiasis continues to decrease, largely on account of the complete delegation of the diagnosis of camel trypanosomiasis to Veterinary Inspectors(where such are available).

The two specimens of T.brucei in the horse were from the Gambeila Enclave, and the T.congolense specimen from El Obeid, infection in the last case having doubtless originated in the known tse-tse area in the Nuba Mountains.

The single bovine case (T.congolense) was diagnosed in material received from the Wadi Halfa quarantine, but the beast probably came from Kordofan.

The only two cases from which special information was obtained were the two T.brucei infections in donkeys. These had been engaged in transport work in the Upper Nile Province but had been temporarily withdrawn to Khartoum (Gebel Aulia). These cases were taken over by the Laboratory and will receive further mention in the section dealing with research.

The single case of T.brucei in a mule was received from Southern Darfur.

2. PIROPLASMOSIS.

The only noteworthy cases were of Theileria annulatum (dispar) infection in two recently imported young Ayrshire bulls. In 1929 a similar case was reported, of one imported Ayrshire bull that developed Tryp.theileri, P.bigeminum and T.annulatum (dispar) infections from the last of which it died. The two cases recorded this year were in the only two European bulls imported, both of which developed a pure Theileria infection and died. In both cases, although "blue bodies" were plentiful in the spleen and liver after death, none were ever seen in the circulating blood.

No attempt is made to classify the other cases of Theileria infection. It is frequently observed in the laboratory that indigenous cattle infected with cattle plague, inoculation contagious pleuro-pneumonia and other conditions, shew Theileria in the circulating blood. It seems that the local cattle are naturally premunised against the local parasites and tolerate them perfectly. To imported European cattle, however, at least one species of Theileria constitutes a very severe menace.

3. BOVINE LYMPHANGITIS.

The first diagnosis of Actinomyces farcinicus infection in the Sudan was reported in 1929. This year two more cases have been diagnosed, one at Kosti and one at El Obeid.

4. ANTHRAX.

This disease is rarely diagnosed in the Sudan. The three cases reported were in a cow and a camel at Kassala and a sheep in Wadi Halfa quarantine.

5. EPIZOOTIC LYMPHANGITIS.

The total number of positive diagnoses does not sensibly differ from that in earlier years. The following table shows the distribution and species concerned in the cases diagnosed.

TABLE I.

Positive diagnoses of epizootic lymphangitis classified by provinces and animal species.

Province	Horses	Mules	Donkeys	Total
Kordofan	11	6	1	18
Blue Nile	--	2	13	15
Fung	2	10	1	13
Upper Nile	1	6	--	7
Khartoum	1	4	--	5
Kassala	2	2	--	4
White Nile	--	1	--	1
Berber	--	1	--	1
Total ...	17	32	15	64

The brief clinical notes supplied by the senders of specimens have as usual been very instructive. The main conclusion to be drawn from them is that neither the nakedeye appearance nor the site of a suppurating sore is of much value in arriving at a diagnosis (excepting in this statement the old-standing cases presenting extensive cording of the subcutaneous lymphatic vessels).

Regarding in particular the site of the lesions the following is a selection of rather unexpected positive cases that have been recorded during the year.

(a) Horse, Kassala Province. Ulcer in inner canthus of eye.

(b) Horse, Fung Province. Large tumour under lower jaw. Not suppurating, no cording of lymphatics.

(c) Mule, Fung Province. Pea like tumour on eyelid.

(d) Mule, Khartoum Province. No external lesions of any kind; the mule had merely flagged in work for some months. Advanced pneumonia due to.

CRYPTOCOCCUS FARCIMINOSUS on P.M.

(e) Mule, Fung Province. Pus smear from lung.

Of these the last two cases are the most striking, but as a number of apparently primary pneumonia specimens held over from last year for histological examination afforded a similar diagnosis a fairly detailed study was made of them. Records will be found in the later section on research.

III. CONTROL OF CAMEL TRYPANOSOMIASIS.

There has been no significant change in the routine method of control throughout most of 1930, but towards the end of the year the mercuric chloride test, which had been the subject of considerable study in the laboratory, and had been tried in the field on a small scale by some Veterinary Inspectors, was officially adopted as the approved routine method of diagnosis.

The routine method of treatment still consists in the intravenous administration of a single dose of ten grammes of Naganol (Bayer 205). As has already been recorded, it is known that this is an unnecessarily large dose in many cases, but it has been provisionally retained as it has proved itself to constitute an absolute cure as a single dose. Experiments have, however, been started, with the co-operation of certain Veterinary Inspectors, to test the efficacy of smaller doses in camels that can be kept under sufficiently close personal observation after treatment to afford adequately checked results.

One additional operation has been incorporated in the routine method of control, namely, to inject all donkeys in close contact with a camel unit with one gramme of Naganol. The evidence on which this decision was made is set out in the section on research.

IV. CATTLE PLAGUE.

The production of cattle plague antiserum has been the largest of the routine duties of the laboratory and has given rise to much more work than the volume of serum ultimately produced would indicate.

The permanent buildings at Malakal were not erected and work had again to be carried out, as in earlier seasons, in temporary grass huts. Also, owing to the late delivery of the cattle required, a very late start was made; instead of serum being issued in adequate quantities in January, the first issues were made in mid February and it was not until the end of March that supply was equal to the demand. In this Report for 1929 it was pointed out that the amount of serum prepared was little more than barely sufficient to supply demands up to the end of the year; thus, in order to supply demands during January and February of this year it was necessary as an emergency measure to prepare a few thousand doses in Khartoum.

Later in the year cattle plague became so widely reported throughout the country as to make it certain that even if the Malakal laboratory prepared the whole of the serum required according to the original estimate (which it did) supplies would be quite inadequate. A second emergency supply, and towards the end of the year a third, had therefore to be prepared in Khartoum.

Ultimately the net issue of serum was 2840.6 litres (56,802 nominal doses of 50 c.c.) of which 34,320 doses were prepared at Malakal and 22,482 doses in Khartoum, and it cannot be claimed that this quantity was adequate.

The emergency preparation of serum in Khartoum is not only much more expensive than at Malakal, but having as a rule to be carried out at short notice, with little apparatus (the bulk being at Malakal) and with a reduced staff, it entails the disorganisation of whatever research work is already in progress, and inhibits even more the institution of any new experiments. For example, it was necessary on one occasion to prepare serum in Khartoum when, in addition to ordinary routine work, a rather extensive experiment on contagious bovine pleuro-pneumonia was in progress, and the available staff in addition to myself consisted of two native laboratory attendants and four cattle men.

Approval has since been obtained for the extension of the buildings at Malakal and for increases in unclassified staff capable of producing at least 100,000 nominal doses of serum annually, although in 1931 it is not intended to aim at more than 60,000 doses since the staff will not be trained and the additional buildings not completed.

It should in this connection be pointed out that it is not sufficient merely to produce enough serum yearly for average annual requirements; adequate supplies should be available for maximum demands, and should, further, be so immediately available that threatened cattle can be protected in the earliest stages of an outbreak. As has been recorded by the Director of Veterinary Services in recent Reports, it is extremely difficult to estimate for even annual requirements; it appears that as cattle owners increasingly regard serum (and other products) with confidence rather than apprehension, a greater number of outbreaks of disease is being reported. For the six years prior to our preparing our own serum the annual requirement was on an average 13,000 doses; in the three following years it was 18,000, 31,000 and 56,000 odd respectively. It is not therefore considered that estimates of 60,000 doses for 1931 and 100,000 doses for 1932 are excessive.

The appointment of a Veterinary Inspector to the Upper Nile Province and the new method of organising cattle supply, whereby all cattle for the succeeding season's work are collected at the end of the current season, should ensure that serum production will start as soon as local conditions are favourable. For the 1931 season all cattle were collected in 1930, the prospective serum producers being immunised against cattle plague and contagious bovine pleuro-pneumonia, and the prospective virus producers against the latter only, being thereafter herded in small segregated camps. Serum production for the 1931 season actually started on 31st. December 1930.

V. CONTAGIOUS BOVINCE PLEURO-PNEUMONIA.

There has been no significant change in the type of vaccine issued for field use, the material injected being a single dose of attenuated living virus culture. The policy of issuing the "youngest safe subculture" has not been strictly carried out, since somewhat older cultures (over 30 generations in subculture) had at one period to be issued owing to the inability to obtain material for the isolation of new virus cultures.

The number of doses issued dropped to 15,700, as compared with 28,170 in 1929, doubtless owing to the greater urgency in all districts of cattle plague outbreaks.

It had been hoped to carry out more deliberate research on the question of the "youngest safe subculture", but this was impossible as the result of other demands on the laboratory and the only guide was the assessment of reports from the field. The information received was as follows :-

No. of doses	15,700
No. of abnormal local swellings	51
No. of deaths	17

The number of deaths that could be attributed to the injection of the Vaccine was thus 1.08 per thousand. It is not at present possible to discuss this mortality to advantage; it may, however, be to some degree appreciated by considering the following circumstances :-

1. In order to ensure that immunity is developed as soon as possible after vaccination the policy is adopted of issuing the "youngest safe subculture" as vaccine (see this Report 1927)

2. Although the above procedure is accepted as a principle it has not yet been possible to investigate it thoroughly in the laboratory, owing to one's energies having been forced in other directions. By keeping records of the age of all subcultures issued to the field it has, however, been possible to accumulate a considerable amount of evidence on this point.

3. During the past three years, admitting that the policy has been to approach the danger line as closely as possible, the deaths that have been reported as directly attributable to vaccination have been of the order of one per thousand. The actual figures are :-

Year	Doses	Abnormal swellings	Deaths
1928	17,590	21	11
1929	28,170	120	29
1930	15,700	51	17

representing an average mortality of 0.92 per thousand.

4. Without for the present intending to discuss details, it may be recorded that the accidents and deaths as the result of vaccinaction have not hitherto been always referable to the younger subcultures.

5. In consideration of the foregoing observations, and while recognising that a good deal more research is necessary, it does not seem that any departure from the present policy is indicated.

Certain experimental work on contagious bovine pleuro-pneumonia was carried out during the year and will be recorded in the section on research.

VI. MISCELLANEOUS.

In addition to the usual miscellaneous activities of the laboratory, such as the issue of technical stores, collection of pathological specimens etc., a considerable amount of time has been taken up in arranging for the erection and extension of the new laboratory at Malakal, the primary function of which will be to produce the country's requirements of cattle plague antiserum. Designs have also been submitted for accommodation and equipment of the research section in the proposed new veterinary buildings in Khartoum, as the present laboratory site, always inconvenient, is now becoming also inadequate for the work required.

C. RESEARCH.

In this Report for 1928 and 1929 mention was made of the progressive difficulty of carrying out ~~r~~ research work owing to the continued increase of routine duties. During 1930 the position has not improved, but certain research has had to be carried out on contagious bovine pleuro-pneumonia vaccine, and material has presented itself in connection with epizootic lymphangitis and trypanosomiasis that could not be neglected. In the absence of an Assistant Veterinary Research Officer the researches were not eagerly undertaken, and the repeated demands for emergency supplies of cattle plague antiserum almost caused their suspension. Certain valuable information was, however, obtained, and is set out under appropriate headings.

I. CONTAGIOUS BOVINE PLEURO-PNEUMONIA.

1. KEEPING QUALITIES OF VACCINE.

With the present policy of attempting to produce immunity as rapidly as possible by using the youngest safe subcultures of virus as a vaccine, there is no doubt that the most urgent factor demanding research is that of attenuation by subculture. As shown, however, in the section on routine, vaccines as at present issued are provisionally taken to be sufficiently safe in consideration of this policy, and demands from the more distant stations in the Sudan for information on the keeping qualities of the vaccine have made it more immediately necessary to carry out experiments designed to throw light in this direction.

Experiments carried out in the laboratory and recorded in this Report in earlier years were with cultures of five or six days' growth at 37°C, these cultures being injected immediately on withdrawl from the incubator. The three main objections to interpreting the results as entirely applicable to field practice were :-

(a) In order to supply a vaccine of approximately known qualities to a station even at a short distance from, a fresh supply of vaccine would have to be made for each requisition. This would necessarily entail a delay of some days, and in addition would often be inconvenient for the laboratory, as a larege order for vaccine might clash with other work. Failing more precise knowledge, however, the method of preparing batches of vaccine specially for each requisition has always been carried out in this laboratory.

(b) In the case of the more distant staions even this procedure would be largely discounted because of the length of time necessary for the vaccine to reach its destination.

(c) In any case, veterinary officers in the field could not be certain that they would be justified in using vaccine that had been in their possession even for relatively short periods. In the absence of fairly precise knowledge of the rate of deterioration it would be at least possible that its injection would be a sheer waste of energy, and in addition, by doing no good, would be harmful to the veterinary reputaion.

(The question of deterioration of the vaccine was urgently raised during the first few seasons in which it was used on a general scale, and in 1928, although it was not possible in that year to carry out any deliberate research in the laboratory, arrangements were made to carry out certain field observations. In collaboration with the Veterinary Inspector, Darfur Province, (Capt. T. Menzies) it was arranged that certain well checked samples of vaccine should be injected into cattle destined for export to Egypt for slaughter; in particular, vaccine was to be used immediately on receipt, and after storage in Darfur for one, two, three ... etc. weeks, a few cattle of each batch being specially branded. The further intention was to pick out some of these cattle from the mob on their arrival at El Obeid and have them sent to Khartoum for testing as to immunity.

This scheme failed to provide the required information. On one occasion a consignment of vaccine was prepared for dispatch in the usual way, but as the Governor of Darfur was returning from Khartoum by aeroplane, and was desirous of encouraging vaccination in his Province, he took the vaccine with him. Cattle vaccinated with it were later tested and found to be immune, but this successful result may be largely discounted because the vaccine had not been submitted to the normal conditions of transport by road. On some occasions the specially marked cattle were identified at El Obeid the owners would neither allow the cattle to be tested under guarantee of compensation, nor sell them for any but ridiculously high prices.

The work was, however, not entirely without result, and such observations as were recorded were definitely encouraging. Actually only two immunity tests were carried out, summaries of them being as follows :-

1st. Test.

Vaccine of 72nd. subculture in serum peptone broth.
" issued 11.5.28.
" dispatched 14.5.28 (by air).
" injected 19.5.28.
Immunity test 26.8.28 (14 weeks' interval).

The immunity test was carried out by injecting four vaccinated bulls and one control bull subcutaneously with 1 c.c. of fresh "tumour virus". The results were :

Bull No.	Symptoms
1	Fever 7th.-17th. days. Swelling over same Period, maximum 10 X 8 in. Recovered.
2) 3) 4)	No symptoms. Recovered.
Control Bull 24.	Typical progressive "pleuro-pneumonia tumour", slaughtered *inextremis* 20th. day.

2nd Test.

Vaccine of 26th. subculture in serum peptone broth.
" issued 10.6.29.
" dispatched 10.6.29 (One day on train, 8 days' delay and road transport).
" arrived 19.6.29.
" injected 23.6.29.
Immunity test 7.8.29 (6½ weeks' interval).

The technique of the immunity test was as in the first case, the result being :-

Bull No.	Symptoms.
1	No systemic symptoms. Swelling less than 1 X 1 in. on 10th. day and resolved by 14th. day. Recovered.
2	As No. 1. Recovered.
3	Progressive "pleuro-pneumonia tumour". Died 16th. day.
4	No symptoms up to 15th. day, when bull died as the result of an impacted rumen.

Controls.

Bull 333	Progressive "pleuro-pneumenia tumour". Died 15th day.
" 334	As 333, died 14th. day.

DISCUSSION.

In the first test a 72nd. subculture was used as vaccine and was injected only eight days after issue, following transport and storage under good conditions. The temperature to which it was submitted was probably in the region of 30°- 35°C. In consideration of the results of experiments carried out in 1927 it would not be expected that a fresh culture of the 72nd. generation would produce a solid immunity in appreciably less than 14 weeks, so that even admitting good transport conditions the recovery of all four bulls tested, three of them without symptoms, showed that the interval of eight days did not give rise to appreciable deterioration.

In the second test a 26th. subculture constituted the vaccine and it was submitted to fairly severe conditions for 13 days; in particular it was probably submitted daily to a temperature of at least 35°C for several hours. Referring again to the experiments of 1927, it would be expected that a fresh culture of the 26th. generation would produce a solid immunity in a period of between one and two months. The death, therefore, of one of the four bulls tested after an interval of six and a half weeks does not indicate that any great deterioration of the vaccine occurred.

As the result of the two foregoing small tests, and in view of the difficulty of obtaining a sufficient quantity of evidence by this method of observation, a deliberate laboratory experiment was carried out in 1930, of which the following is a summary.

SCHEME OF EXPERIMENT.

A virus culture of moderate attenuation, actually a 21st. (weekly) subculture, was selected, and a large number of tubes of serum peptone broth inoculated. After incubation for five days at 37°C they were divided into two lots, one of which was further stored at a temperature of 37°C and one in a mixture of ice and water. In order to reproduce as far as possible the conditions of storage of vaccine issued to the field, all tubes were sealed.

Every week from the second week onwards two or three tubes were taken from each lot, tested individually for vitality by making subcultures both in liquid and on solid media, and the tubes of each lot mixed to make an average sample. Four bulls were then injected with 2. c.c. of vaccine, two each with a mixture of cultures stored in the incubator and in ice-water respectively. This was repeated until the twelfth week, not so much because cultures do not normally survive for more than three months as that it would be unlikely that in using a vaccine in the field a storage period of this length would ever be exceeded. The experiment was completed by testing the vaccinated cattle as to immunity at a later date.

The most difficult problem that presented itself was to decide at exactly what interval after vaccination the immunity tests should be carried out in order to provide the maximum of information. Decision was ultimately based on results obtained in experiments carried out in 1927. The results of these were interpreted to show that with weekly subculturing the progressive attenuation of the virus could be demonstrated by the increasing length of time required after vaccination for immunity to develop; further, as far as could be judged from having used only 20 odd head of vaccinated cattle in those experiments, a fresh culture of about 20 generations would probably produce immunity after an interval of between one and two months.

It was fairly certain in the present experiment that some degree of deterioration would occur, even after a relatively short period of storage, but the few preliminary tests of cattle vaccinated in Darfur indicated that after a period of two or three weeks' storage, even in what might be considered as unfavourable conditions of temperature, this deterioration was not very marked.

Ultimately it was decided to carry out the immunity test in two halves :-

(a) Cattle injected with vaccine stored up to a period of six weeks to have their immunity tested after an interval of rather more, but not much more, than two months.

(b) The remainder to be tested later, the exact interval to be decided after studying the results of the first half of the test.

The first lot were accordingly tested three months after the last bulls in the group were vaccinated, and the results were such that the second lot were tested after an interval of about six months.

Unfortunately, at about the time when the last vaccinations were being carried out cattle plague appeared in the laboratory and killed a certain number of the cattle. Fortunately, however, in no case were both cattle of a pair given identical vaccine infected.

The results of the immunity tests of the survivors which are shown in Tables II and III, are the only observations that it is considered necessary to record in this report. Certain subsidiary observations, having less bearing on the primary object of the experiment, are omitted.

TABLE II.

Immunity test of cattle vaccinated with a C.B.P.P. culture of 21st. generation stored for periods of from two to six weeks at 37°C and 0°C respectively. Virus injected 7.4.30.

Period of storage of vaccine	Temp. of Storage	Interval between vaccination & test	Bull No.	Symptoms	Result
2 weeks	37°C	16 weeks	382	Progressive local swelling and fever	Died 27th. day
	37°C		383	Swelling (less than 1 x 1 in. only ~~inch) only~~.	Recovered.
	0°C		386	No symptoms.	Recovered.
3 weeks	37°C	15 weeks	377	Progressive local swelling and fever ~~fever~~.	Died 22nd. day
	37°C		389	No symptoms.	Recovered.
	0°C		226	No symptoms.	Recovered.
4 weeks	37°C	14 weeks	390	Swelling 9th-18th days, maximum 4 x 3 inches	Recovered.
	37°C		391	No symptoms.	Recovered.
	0°C		392	Progressive local swelling and fever ~~fever~~.	Died 22nd. day
	0°C		393	No symptoms.	Recovered.
5 weeks	37°C	13 weeks	399	Swelling 7th-14th days, maximum 2 x 1 inches	Recovered.
	37°C		398	No symptoms.	Recovered.
	0°C		400	No symptoms.	Recovered.
6 weeks	37°C	12 weeks	402	Progressive local swelling and fever	Died 22nd. day.
	37°C		403	" " " " "	Died 30th. day.
	0°C		407	No symptoms.	Recovered.
			495	Large C.B.P.P. swelling on 12th day on which day bull died of cattle plague.	
		Controls	509	Progressive local swelling and fever.	Died 16th day.

TABLE III.

Immunity test of cattle vaccinated with a C.B.P.P. culture of 21st. generation stored for periods of from seven to twelve weeks at 37°C and 0°C respectively. Virus injected 30.8.30.

Period of storage of vaccine	Temp. of storage	Interval between vaccination & test	Bull No	Symptoms	Result
7 weeks	37°C	30 weeks	425	Swelling 7th & 8th day less than 1x1in.	Recovered.
	0°C		428	Fairly large swelling 14th-30th days, Maximum 10 x 10 inches.	Recovered.
8 weeks	37°C	29 weeks	440	No symptoms.	Recovered.
	37°C		441	Swelling 7th-10th days Maximum, 1x1 in	Recovered.
	0°C		442	Swelling 7th-21st days Maximum, 4x4 in	Recovered.
	0°C		438	Swelling 7th-14th days Maximum, 3x3 in	Recovered.
9 weeks	37°C	28 weeks	436	Swelling 7th-17th days Maximum, 3x3 in	Recovered.
	0°C		439	Swelling 14th-17th days " 1x1 in	Recovered.
10 weeks	37°C	27 weeks	448	Swelling 5th-17th days Maximum, 6x6 in	Recovered.
	37°C		453	Swelling 7th-15th days Maximum, 3x3 in	Recovered.
	0°C		451	Swelling 7th-12th days Maximum, 4x4 in	Recovered.
	0°C		452	No symptoms.	Recovered.
11 weeks	37°C	26 weeks	466	Swelling 3rd-19th days Maximum, 7x7 in	Recovered.
	0°C		472	Swelling 4th-16th days Maximum, 7x7 in	Recovered.
12 weeks	0°C	25 weeks	462	Progressive local swelling and fever.	Died 44th.day.
			464	Swelling 15th-38th day Maximum, 3x3 in	Recovered.
		Controls	511	Progressive local swelling and fever.	Died 24th.day.
			515	" " " " "	Died 25th.day.

DISCUSSION.

(a) First half of test. Reference to Table II leads to the following conclusions :-

(i) The vaccine deteriorated on storage, both in ice-water and in the incubator, as is shown by the incomplete immunity of the test cattle.

(ii) Generally speaking, the deterioration was not very marked, in consideration of the length of time the vaccine was stored and the interval required for a perfectly fresh culture of a similar number of subcultures to produce immunity. Of sixteen cattle tested eleven recovered after showing mild or no symptoms.

(iii) Vaccine stored at 37°C deteriorated more than that stored at 0°C. Four out of ten bulls injected with the former succumbed when tested, while of six injected with the latter one only died.

(iv) The small number of cattle in each group makes it impossible to offer any opinion on the relative rate of deterioration, even in the case of vaccine stored in ice-water. The records do not even indicate that deterioration was progressive, although it certainly must have been so.

(b) Second half of test. Having found that there is a slight deterioration of the vaccine on storage, and presuming that the degradation of antigenic value must be progressive, it seemed that the only additional information obtainable from the remaining cattle would relate to the maximum permissible period of storage. The interval between vaccination and testing had therefore to be sufficient to afford an opportunity for an extremely degraded antigen to induce whatever degree of immunity it could. Such interval could not be calculated, but it was decided to test the remaining cattle after twice the interval allowed in the first half of the test, namely, about six months after the vaccination of the last group of beasts.

Reference to Table III shows that :-

(i) Fifteen of the sixteen cattle submitted to immunity test survived, showing, as judged by the relatively mild symptoms, a fairly strong immunity.

(ii) No significant difference could be detected in the immunity of cattle vaccinated with virus culture stored at 0°C and 37°C.

(iii) That the one beast which died had received vaccine stored for the longest period and was tested after the shortest interval is hardly to be interpreted in any absolute manner. That it did not die until the 44th. day is almost certainly an indication of some degree of immunity, since this survival period is not only much greater than that of the controls but is far greater than in any of over 100 control and virus passage cattle of similar type of which records have been kept in the laboratory.

SUMMARY.

Considering the test as a whole, and viewing the results both from immunological and practical standpoints, the conclusions to be drawn are as follows :-

IMMUNOLOGICAL.

(a) The antigenic value of virus culture becomes degraded on storage.

(b) The degradation can be appreciated in the same way as that which occurs as the result of repeated subculturing, namely, by the slower rate of development of immunity in vaccinated cattle.
(c) Degradation is more rapid on storage at 37°C than at 0°C, but not to a very marked degree.

PRACTICAL.

(a) It is advisable to use virus culture vaccine as soon after preparation as possible.
(b) Owing to the relatively slow rate of deterioration on storage in the cold over short periods it is permissible to carry small stocks in the laboratory.
(c) Owing to the more rapid deterioration of vaccine when stored at 37°C, a temperature that may be accepted as fairly representative of shade temperatures in outstations in the Sudan, the control of contagious bovine pleuro-pneumonia by vaccination assumes two aspects :-

(i) In the case of herds in which the disease has already appeared, or for herds imminently threatened, vaccination should be conducted with cultures freshly issued from the laboratory. In such herds a rapidly induced immunity is of the first importance, and it has been seen that a storage period of even a fortnight at 37°C retards the rate of immunity development.

(ii) In the case of herds less imminently threatened, or for herds in which vaccination is to be adopted as a long range precautionary measure it is, although still desirable, not so necessary to use the freshest possible cultures; storage at 37°C for ten or eleven weeks would in extreme instances be permissible.

2. OBSERVATIONS ON A NATURAL OUTBREAK.

Although the following short note is not compiled as the result of deliberate research it provides original information of considerable value, in that it deals with a natural outbreak of the disease in which control measures were deliberately not employed. In the available literature only one reference can be found to the morbidity rate in the absence of veterinary control, namely by WALKER(Ann.Rep. Dept. Agri. Kenya, 1929). In this instance 34 non-vaccinated cattle were herded as controls for periods of between three and five months with a number of vaccinated and infected animals; of these 14 became infected (41%), none died, and five were presumed to have recovered.

The outbreak observed in Khartoum occurred in cattle being employed for the production of a small emergency supply of cattle plague antiserum, and as they were in any case destined for early slaughter it was decided not to adopt any control measures; when a case was diagnosed clinically it was not slaughtered or isolated but was allowed if possible to live until a suitable day for bleeding to death for serum.

The conditions and observations, briefly summarised were as follows :-

(a) A total of 51 cattle was involved, obtained by purchase by a local cattle merchant from various sources in the open market.

(b) These were picketed out in an open yard, not in buildings. They were thus in fairly close contact but in the open and unable to mix freely. They all, however, periodically visited the same operation shed for hyperimmunisation and bleeding.

(c) Of the total number of cattle, 48 were exposed to infection for at most 50 days (some died or had to be destroyed earlier) and three for 29 days only.

(d) All cases diagnosed or suspected during life were confirmed on post-mortem examination, and all apparently uninfected ones were likewise examined to the degree of searching the lungs.

The number of cattle that became infected was :-

Clinically diagnosed during life :-	
(i) Died	3
(ii) Survived until bled to death	10
Diagnosed on post-mortem only	5
Total	18

Note : Included in the above figures is the first case diagnosed, from which the others are presumed to have become infected.

It is not intended to discuss these results at length. Considered in conjuction with Walker's observations, however, this small outbreak constitutes a useful item of evidence, although from a slightly different standpoint, as to the losses that an outbreak of contagious bovine pleuro-pneumonia may cause if no control measures are exercised. In Walker's records, 14 cattle out of 34 exposed under very open conditions of herding became infected within a period of at most five months; in the present outbreak 18 out of 51 became infected under less open conditions of herding in a period in no case exceeding 50 days.

II. TRYPANOSOMIASIS.

1. THE POSSIBLE EXISTENCE OF EQUINE RESERVOIRS OF THE COMMON LOCAL CAMEL TRYPANOSOME, (T.soudanense).

It may be claimed that in regard to diagnosis and therapeutic treatment the control of camel trypanosomiasis in this country leaves little to be desired. A point, however, that has not hitherto received much consideration is the possible existence of "reservoirs" of other animal species, and in the Sudan the two species calling for attention are the horse, and more particularly the donkey.

By way of introduction it is worthy of record that up to the time of undertaking studies in this connection no case of infection due to trypanosomes of the T.evansi type had ever been diagnosed in equidae in the Sudan, although in the French African territories and to a lesser degree in Egypt such infections are not uncommonly reported.

Thus the experiments now to be recorded were designed not with the intention of ascertaining whether T.soudanense constitutes an appreciable danger to horses and donkeys, because there is sufficient evidence that in the Sudan it does not; the point at issue has been the possibility of horses and donkeys being "carriers" or "reservoirs" of the trypanosoma, and so constituting a danger to the camel. It was decided to give more particular attention to donkeys because as a species they normally come under less observation than horses.

The proposed series of investigations was as follows:-

(a) Is it possible to infect local donkeys with the local strain of T.soudanense ?

(b) Is the course of the disease of such a nature that it might escape clinical notice, including microscopic examination of the blood ?

(c) Do infected donkeys recover spontaneously ?

(d) Is it possible to cure them - the therapeutic agent in mind being Naganol ?

(e) Is it not possible that a more careful search will reveal naturally occurring cases ?

Experiments were started at the end of 1927, but it was not until early in 1930 that sufficient data were accumulated to make a report profitable; in particular the question of possible natural infection had not been settled. The following is a summary of experimental observations.

(a) Possibility of artificial infection. 12.11.27.

Three donkeys were purchased, proved free from infection by the inoculation of white rats, and infected directly from a camel with T.soudanense.

Daily microscopic examination of the blood demonstrated an identical type of infection in all donkeys. Trypanosomes appeared in every case on the seventh day.

(b) Course of the infection.

Temperatures were taken twice daily and blood was examined daily, and again in all three cases an identical course presented itself, namely, intermittent attacks of mild fever lasting three or four days but at very irregular intervals. The febrile periods were always coincident with the presence of trypanosomes in the blood, but conversely trypanosomes were often present for several successive days without associated fever. The donkeys fed well throughout and did not lose condition; one of them was regularly used for light work and showed no loss of condition as compared with the two others. In fact, failing the regular employment of thermometer and microscope no abnormality would have been noticed in any of the donkeys. Observations of this order were noted for ten weeks in the case of two of the donkeys, following which no fever, no trypanosomes and no loss of condition were recorded up to a total period of seven months. The third donkey was treated after about five weeks.

(c) Possibility of spontaneous recovery.

When treating the first donkey the other two were left untreated as controls (treatment was one gramme of Naganol intravenously). As seen in para. (b) the two untreated individuals continued for some time to present the same symptoms as at the outset, but when, after the 68th. and 70th. day respectively, no symptoms or blood invasion could be demonstrated there was a reasonable doubt as to whether they had not recovered spontaneously, thus negativing the apparent cure of the treated donkey. On 10.6.28, 211 days after infection and 143 and 145 days respectively after trypanosomes had last been seen in the blood, samples of blood from both donkeys were injected into white rats, all of which developed trypanosomiasis.

(d) Possibility of cure.

It has been mentioned that one donkey was given one gramme of Naganol intravenously in the early stages of infection, (actually on the 39th. day), the two others being retained as controls. In the first donkey no trypanosomes were again seen, nor was any fever recorded. Five and a half months after treatment two white rats were injected with its blood and remained healthy.

The two other donkeys, having served their purpose as controls, were now treated, moreover in the chronic stages of the infection. Both were given one gramme of Naganol, 161 and 163 days respectively after trypanosomes had last been seen in their blood - although white rat inoculation showed them to be still infected. No subsequent blood examinations were made, but two months after treatment two white rats were inoculated with the blood of each donkey; all remained healthy.

(e) Possible existence of natural cases.

The general character of the artificial infection in donkeys made it seem quite possible that natural cases might occur; that none had hitherto been brought to one's notice could be easily understood from the general absence of symptoms, and the improbability of detecting trypanosomes in the blood in any but the earlier stages. It was therefore arranged that a number of donkeys should be examined in a locality notorious for camel trypanosomiasis, namely, Kosti. This was done by Mr. Penbrey (January 1929) who examined 18 fresh blood specimens microscopically and injected 14 samples into white rats, in every case with negative results. At the end of 1929 blood smears were received in the laboratory from a donkey in Gedaref, which had been in fairly close contact with camels in a locality in which camel trypanosomiasis is very common. The blood contained T.soudanense in small numbers. The donkey was at my request sent to the laboratory and the trypanosome type confirmed by white rat inoculation. On arrival the donkey was in poor, but not very poor, condition and feeding well. Examined daily for six weeks, no trypanosomes were seen in the blood, nor was there ever any fever. White rats inoculated three and six weeks after arrival still became infected.

At the end of six weeks the donkey was given one gramme of Naganol, and white rats inoculated one month and two months thereafter remained healthy. Ø On arrival in the laboratory the donkey was in poor condition/as the trypanosome infection.

Regarding the infection in horses, one horse only has been observed, artificially infected from a camel. It showed trypanosomes on the 14th. day and more or less continuously thereafter, becoming ultimately very emaciated in spite of feeding well, and dying at the end of six months. Treatment was not attempted, as the object was to study the course of the disease only.

Ø it improved considerably before treatment and continued to do so afterwards. It is therefore presumed that the work it had been doing was as responsible for its poor condition

GENERAL CONCLUSIONS.

(i) Local donkeys are susceptible to the common local trypanonosome, *T.soudanense*.

(ii) Although natural infection is uncommon, it can occur.

(iii) The course of natural, as also of artificial, infection is such as would lead to the establishment of "reservoirs" of trypanosomes.

(iv) The natural, as the artificial, infection can be cured by the administration of a single intravenous dose of one gramme of Naganol.

(v) In the case of horses there is too little evidence to warrant a conclusion. If natural infecion occurs it must be extremely rare, since no naturally occurring case has hitherto been recorded in the Sudan, and the course of one artificial infection studied indicates that natural cases would come to notice.

(vi) Arising out of the above it will be advisable in dealing with outbreaks of trypanosomiasis in camels to treat all closely associated donkeys. In most instances the operation will be superfluous, but by reason of its ease and cheapness, and the certainty of effecting a cure it will be a useful precaution.

2. TRYPANOSOMA BRUCEI IN DONKEYS.

Towards the end of the year blood smears were sent to the laboratory from some donkeys that had been working in the Upper Nile and had recently been withdrawn to the neighbourhood of Khartoum. Several deaths had occurred and, as many of the donkeys had been working in districts where tse-tse borne trypanosomes occur, "fly" was suspected. *T.brucei* was identified in one blood smear, and three donkeys were on request sent to the laboratory. One of these died immediately on arrival, post-mortem blood examination and white rat inoculation being negative.

Of the remaining two, one had trypanosomes in the circulating blood; white rat inoculation from the other confirmed *T.brucei*. All were very poor.

Both donkeys were given one gramme of Naganol intravenously and were examined daily for ten weeks, during which time they improved in condition and no trypanosomes were seen in the blood. At the end of ten weeks two gerbils (desert mice - highly susceptible to *T.brucei*) were inoculated with the blood of each donkey and remained healthy.

Without wishing to generalise from two cases, it seems that one gramme of Naganol is probably capable of curing *T.brucei* infections in donkeys. This finding has perhaps a limited application in the Sudan, but there is no doubt that it can be employed to reduce a certain amount of loss.

III. EPIZOOTIC LYMPHANGITIS.

A singular, and hitherto unrecorded, phenomenon which is considered to be referable to epizootic lymphangitis has been brought to notice on several occasions recently, namely, an apparently primary pneumonia. It is possible that at the present stage the identity of the causal organism with *Cryptococcus farciminosus* is not sufficiently proved, but such is provisionally assumed on account of the identical morphology, staining reactions, and histological changes occurring in the infected tissues.

It is possible that in some cases the lung is not the primary seat of infection, but from the accumulated evidence it seems certain that in many cases it is. It is considered that the phenomenon has hitherto been missed partly because on the destruction of an animal suffering from epizootic lymphangitis a complete post mortem is rarely made, and partly because in cases of chronic pneumonia, infection with *Cryptococcus farciminosus* is unlikely, in the absence of other lesions, to be suspected.

Before discussing this type of infection in general terms it will be advisable to give brief notes of selected cases, with a view particularly of demonstrating its apparently primary nature, as distinguished from the respiratory lesions that have occasionally been recorded as the result of generalised infection.

CASE No. 1. Khartoum. Abyssinian mule, aged.

Admitted to hospital on 4.9.29 with a sore on the withers. Epizootic lymphangitis not suspected, but pus examined as a routine procedure and found negative. Wound healed with simple treatment and mule discharged. Three weeks later mule admitted to hospital with obscure respiratory symptoms, the most noticeable being laryngeal obstruction, but increasingly shallow breathing suggested that the lungs were also involved. Death ultimately occurred on 23.10.29, about six weeks after the first admission for sore withers and about three weeks after the onset of respiratory symptoms.

Post mortem examination revealed a "tumour" of about 2 c.m. diameter on one arytenoid cartilage, a chain of nodules, the largest being about 1 c.m. diameter, extending downwards under the tracheal mucous membrane, and large solid areas in both lungs.

Material sent to the laboratory was a large piece of one lung, apparently from the dorsum, without trachea, main bronchi or glands. The bulk of the tissue was greyish white and very tough; although the pleura was much thickened there were no adhesions. On section the tissue had the appearance and approximately the consistency of a slab of white indiarubber. Very little exudation occurred at the cut surfaces. Tissue smears stained with Leishman's stain showed a small number of bodies suggestive of cryptococci; duplicates stained by Claudius method confirmed this diagnosis, although at first owing to the very small number of organisms present there was some doubt as to their identity.

[illegible]

It is not proposed to discuss the histology at this point, otherwise than to state that the presence of cryptococci was abundantly confirmed.

CASE. No. 2. Khartoum. Abyssinian mule, aged.

No history of sore of any kind. Admitted to hospital for a chronic cough. Mule was kept under observation for about four months without a definite diagnosis being made, although some form of pulmonary tumour was finally suspected. Mule was ultimately destroyed as no form of treatment was of any use and it was latterly losing condition.

Post mortem examination showed both lungs extensively infected, other organs normal. Material sent to the laboratory was a piece of lung which in appearance was very similar to that of Case No. 1. The infection was not so uniform, giving the lung the appearance of a piece of indiarubber with irregular spongy areas. Exudation, of a semi-purlent consistency, was more plentiful than in the first case, and cryptococci were easily identified.

CASE. No. 3. Darfur, Horse, no detailed description.

No history of sore, and as it was an officer's charger this statement can be entirely accepted. The only history was that it had shown obscure pulmonary trouble for six weeks, no treatment had been of any use and the horse was destroyed.

Post mortem revealed "a large tumour, about 10 lb. weight in the mediastinum and invading the right lung". From this note it may be gathered that this infection differed from the others in being circumscribed and in being confined to one lung. Pieces of the "tumour" sent to the laboratory showed numerous cryptococci.

CASE. No. 4. Omdurman. Cyprian mule, aged.

In September 1929 had had a sore on the breast-probably a breast-collar gall. Epizootic lymphangitis not suspected and smears of pus not examined as the sore rapidly healed under simple treatment. Was in regular work for the next four months, but at some indefinite time during this period it began to tire in work; flanks heaving when working but apparently normal when at rest. Being aged and unable to work, it was destroyed.

On post mortem examination everything appeared to be normal except the lungs, both of which were "solidified" almost completely. A large amount of lung tissue was sent to the laboratory and it was noticed that although the infection was distributed throughout the whole mass, the intensity varied considerably in different parts. Cryptococci abundantly present.

For the brief clinical and post mortem notes on the above cases I am indebted as follows :- Cases 1 and 2, Capt. A.P. MacDonald R.A.V.C., Cases 3 and 4, Capt. T. Menzies and Capt. C.P.Fisher respectively of this Service.

A number of other cases has since come to notice, in some of which cryptococci have been seen, while in others cryptococcus infection has been provisionally diagnosed from the histology.

In giving brief descriptions of the foregoing four cases no mention has been made of the histology, or of any appearances other than the gross superficial ones. It is, further, not intended to enter into a lengthy discussion of the microscopic features in this note. It may, however, be stated that in regard to distribution of the infection in the lungs great variation has been noticed; it seems that many types may occur, as for example in human pulmonary tuberculosis.

Regarding the histology, the process appears to be exactly as in other lesions of epizootic lymphangitis, differing only in that it is applied to pulmonary tissues. While admitting that an exhaustive examination of a large number of specimens has not been carried out, it seems that the changes can be fairly definitely separated into four overlapping stages :-

1. Peribronchial and perialveolar infiltration with small mononuclear cells, apparently lymphocytes, without congestion or the usual signs of inflammation.

2. Replacement of the small mononuclears with other cells mainly large mononuclears, but with a small sprinkling of plasma cells. Lung tissue still recognisable.

3. Lung tissue unrecognisable, degeneration of mononuclears with great swelling. Formation of giant cells. Cryptococci becoming visible in the swollen mononuclears and less so in the giant cells.

4. Breakdown of the swollen mononuclears with great multiplication and liberation of cryptococci.

In addition to the above a variety of secondary changes are to be observed, such as local collapse, passive congestion, oedema and vesicular emphysema, but as these vary in different areas and in different cases they are not essential to the primary process.
Certain negative features are also noteworthy, namely,
1. Complete absence of active congestion, pneumonia or bronchitis in the early stages.
2. Almost complete inhibition of attempts at repair, as shown by absence of fibroblasts and new connective tissue.

The phenomenon requires much more study, but its bare discovery shouod have an important bearing on the control of epizootic lymphangitis - assuming that the cryptococcus at issue is *C.farciminosus.* The possibility of spread by infected sputum should cause all equines with obscure chronic pulmonary conditions to be regarded with suspicion, while the immense number of organisms present in a lung in an advanced degree of infection will make it necessary to exercise the strongest measures in ensuring the proper disposal of carcases;

in some of the above mentioned cases the quantity of infective material in the lungs of a single animal would have been equal to that in a hundred cases having infection limited to superficial sores.

D. PUBLICATIONS.

Owing to the great pressure of routine duties, no papers have been published from the laboratory during the year.

E. SUMMARY.

The year's work may be summarised by stating that the situation arrived at in 1929 has not altered; routine work has remained at a level that has made research almost impossible. The main difficulty during the year has been the supplying of unexpected demands for cattle plague anti-serum; not only was the quantity prepared almost double that for which provision had been made, but repeated demands for additional supplies were made at short notice, these having to be satisfied in spite of a depleted staff and a shortage of apparatus, and also regardless of any other work that was in progress. Reduced demands for contagious bovine pleuro-pneumonia vaccine, and particularly the discovery that the technique of its preparation can be simplified, have afforded a certain amount of relief. The appointment of a Sudanese clerk improved the situation very greatly, and although, on account of pressure of work in other sections of Veterinary Headquarters, a portion of his time has been occupied away from the laboratory, it has been for the first time possible to employ the Laboratory Assistant in technical work throughout the year.

Such research work as has been carried out has been dictated by circumstances rather than choice, but valuable results have been obtained. The keeping qualities of contagious bovine pleuro-pneumonia vaccine have been determined with some finality. The possibility of donkeys acting as "reservoirs" of camel trypanosomiasis has been established, and by further ascertaining that they can be easily cured one more useful measure for the control of the disease has been made available. The curing of donkeys of T.brucei infection with Naganol should also lead to a reduction of losses on a small scale. Pulmonary infections apparently due to Cryptococcus farciminosus have been detected, and partially studied; even at this early stage, apart from the academic interest attaching to the discovery itself, it can be claimed that mere knowledge of the existence of such a type of infection will necessarily be of value in controlling epizootic lymphangitis.

The appointment of an Assistant Veterinary Research Officer to fill a vacancy that has been in existence for nearly four years, occurred too late in the year to have any influence on the work reviewed in this Report. Referring to this appointment it is to be noted that during the existence of the vacancy routine work has so increased that it has been necessary from time to time to ask the Director of Veterinary Services to attach a Veterinary Inspector to the laboratory; during the past two years, moreover, a Veterinary Inspector has been attached for practically the whole of his time. It is greatly to be hoped that routine duties will not occupy the time of the Assistant Veterinary Research Officer to such a degree as completely to inhibit the functions which the name of his appointment implies.

Finally, it is necessary to acknowledge the help of the Director of Veterinary Services and the exertions of my small staff. Only by having received from the former nothing but encouragement and the granting of every possible facility, and from the latter continuous hard work at a pressure that I had not thought possible, has it been possible for the laboratory to fulfil all demands made on it.

(Sgd.) S.C.J. BENNETT,

VETERINARY RESEARCH OFFICER,

SUDAN GOVERNMENT.

Khartoum, 29-1-31.
BMB.

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